

JetWeb: Database and WWW interface for MC tuning and validation.

FNAL MC workshop Group, 5th November 2002

Jon Butterworth



- Physics Motivation
- Technology
- User guide

Motivation

- **Different measurements at LEP, HERA and Tevatron are often sensitive to the same physical effects.**
- **Drawing common physics messages from them is often difficult: different phase space, different processes etc...**
- **We need to draw out these messages to gain quantitative understanding of the hadronic final state, for both current & future experiments.**
- **General purpose simulation and calculation programs provide the means to make the connections.**
- **They are complex, and the measurements often are too. Automation is good!**

Areas of Impact

- **High E_T jets**
 - Jet cross sections; parton showers & matrix elements.
- **Heavy flavour production (charm & beauty)**
 - Production cross sections & dynamics, multiscale QCD.
- **Fragmentation parameters**
 - Strange, charm, beauty, leading particles.

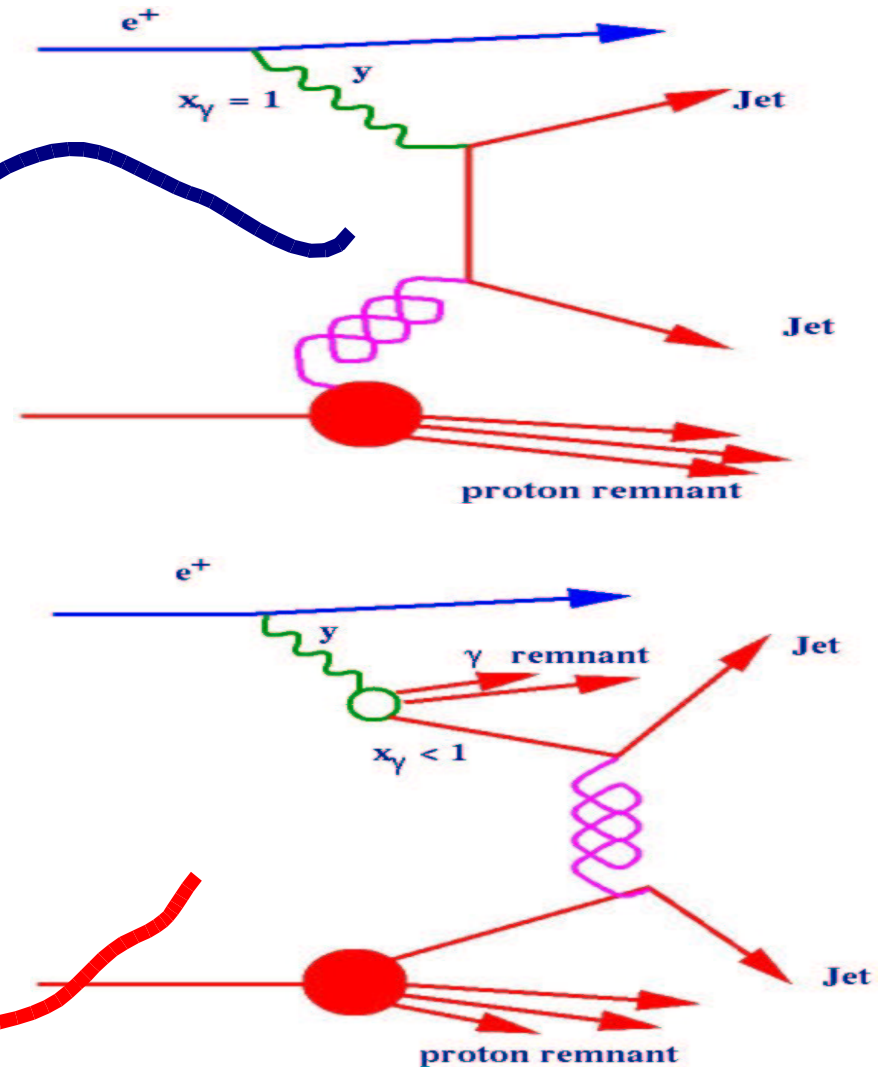
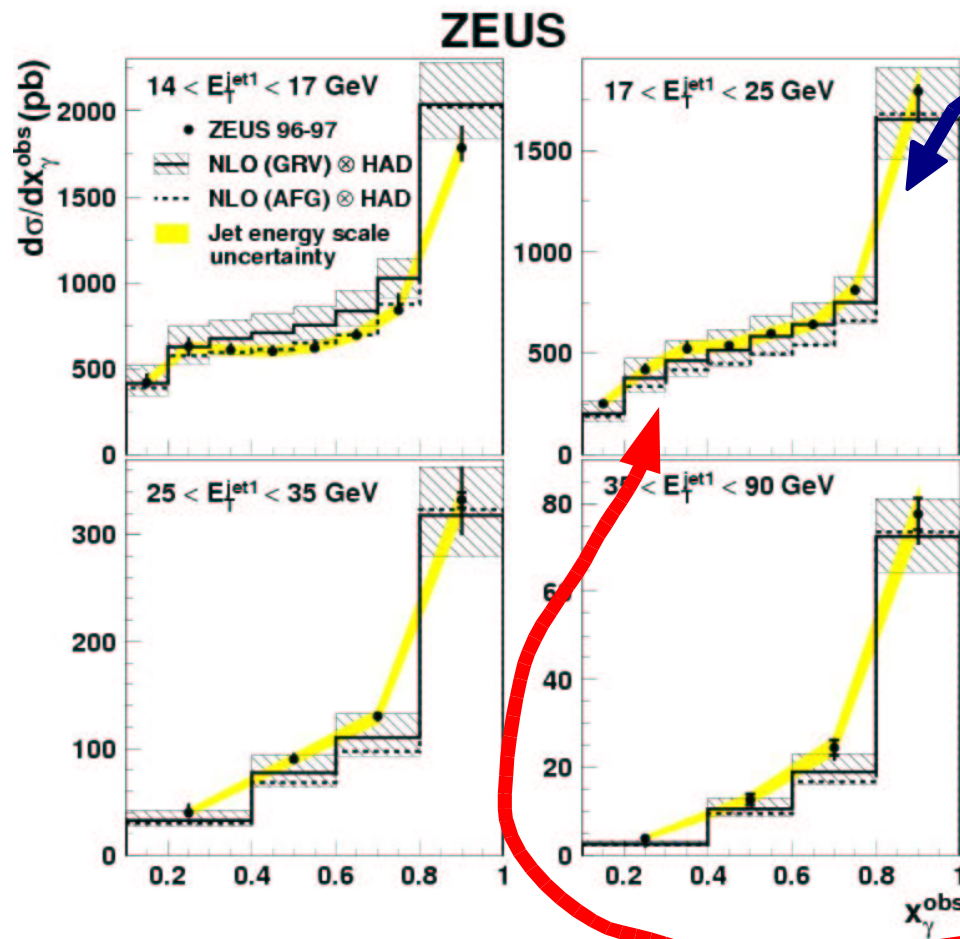
Areas of Impact

- **"Underlying events"**
 - Minijets, multiparton interactions, soft underlying events, saturation.
- **Transverse momentum in the proton & photon**
 - &/or initial state radiation
- **Structure functions / Parton distributions**
 - Also from jets and from charm.
- **Diffraction**
 - Diffractive structure functions, gaps between jets, survival probability.

HERA as a 'hadron-hadron' collider

- Almost on-shell photons come along with the electron beam & collide with protons.
- These photons can fluctuate to acquire a hadron-like structure.
- HERA can look like a **hadron-hadron** machine (**hadronic photon** vs proton) but can also do "simpler" measurements with a pointlike photon. (in Deep Inelastic Scattering or direct photoproduction).

HERA as a 'hadron-hadron' collider



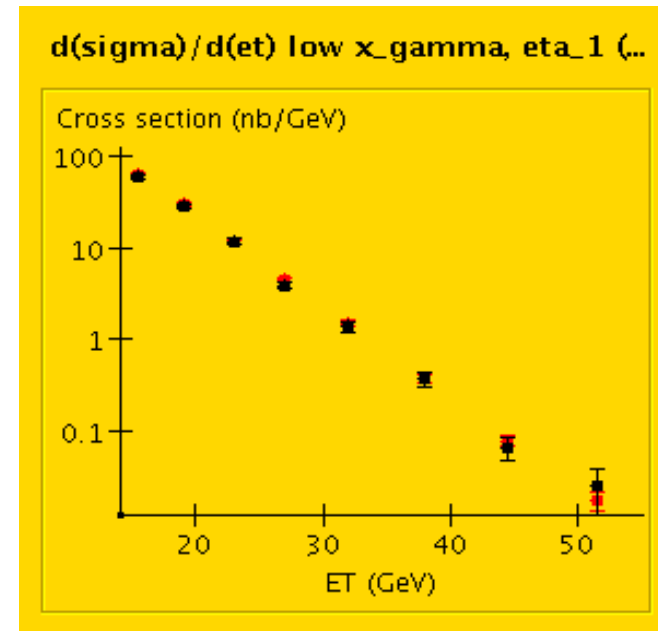
Matrix Elements & Parton Showers

Matching of (N)NLO Matrix elements to parton showers is important for multijet final states at LHC. Several groups working on it. *eg.*

Frixione & Webber, JHEP 0206;029,2002

W+jets, WW+jets, top+jets, Higgs+jets....Sophisticated topological cuts to identify signals at LHC.

How well do fixed-order matrix element programs and LL partons shower simulations do compared to current jet data?



ZEUS dijet cross section for hadronic photon events as a function of the leading jet transverse energy.
Data vs **Herwig x 1.6**.

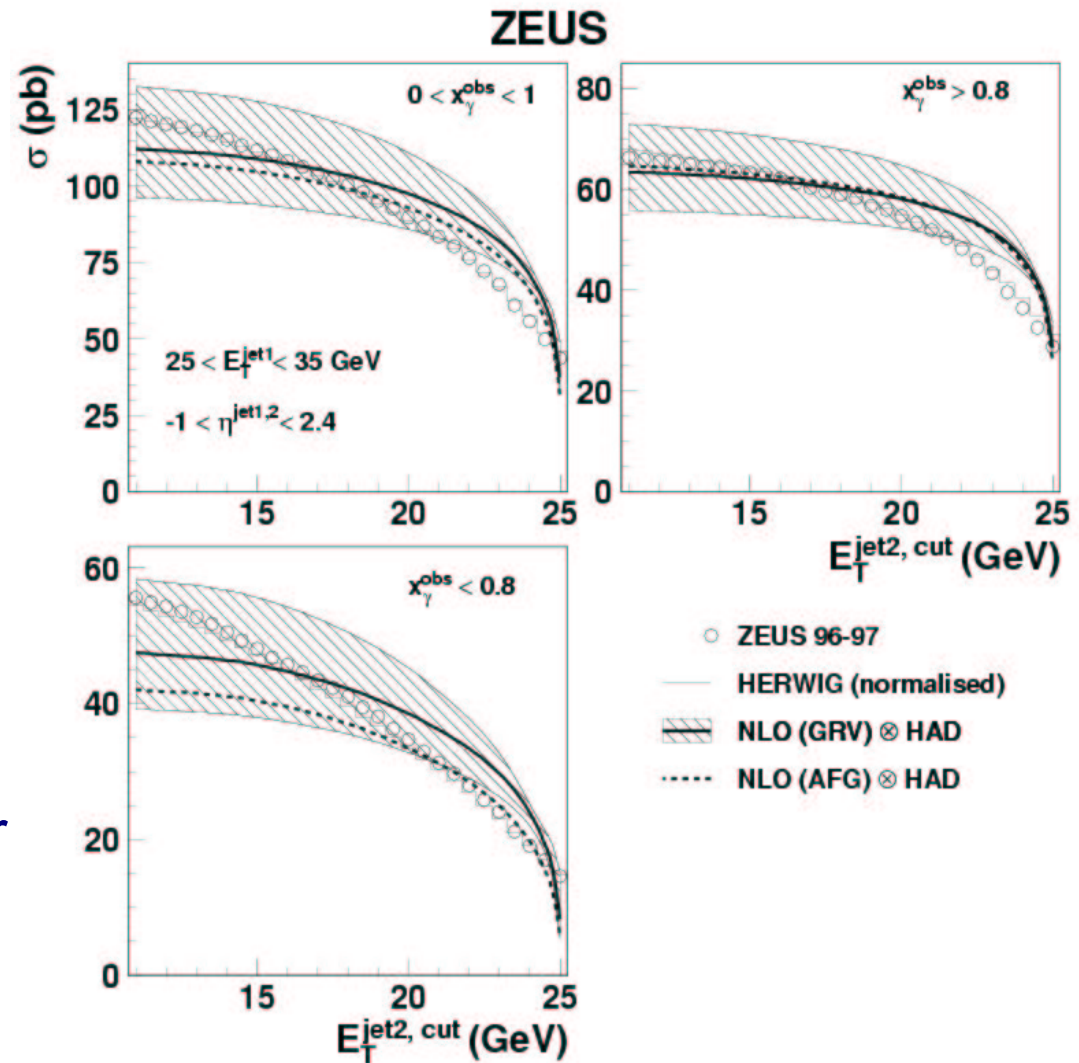
Matrix Elements & Parton Showers

Dijet cross section defined in terms of highest E_T jet and the rapidities of the two jets.

What happens when we vary the E_T of the second jet?

Shape well modelled by HERWIG, not by fixed order NLO.

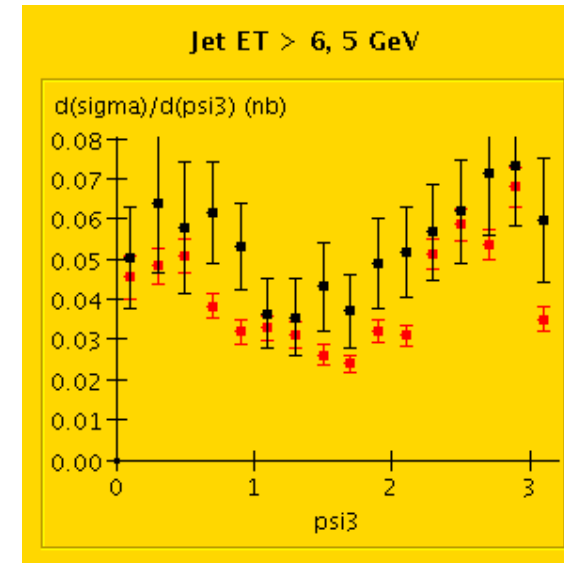
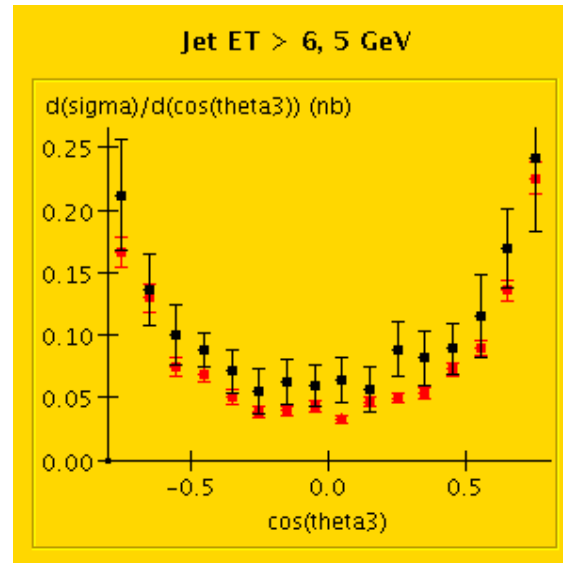
Eur.Phys.J.C23:615-631,2002



Three-Jet Cross Sections

Three-jet cross sections for $M_{jjj} > 50$ GeV

Colour Coherence in initial & final state radiation.

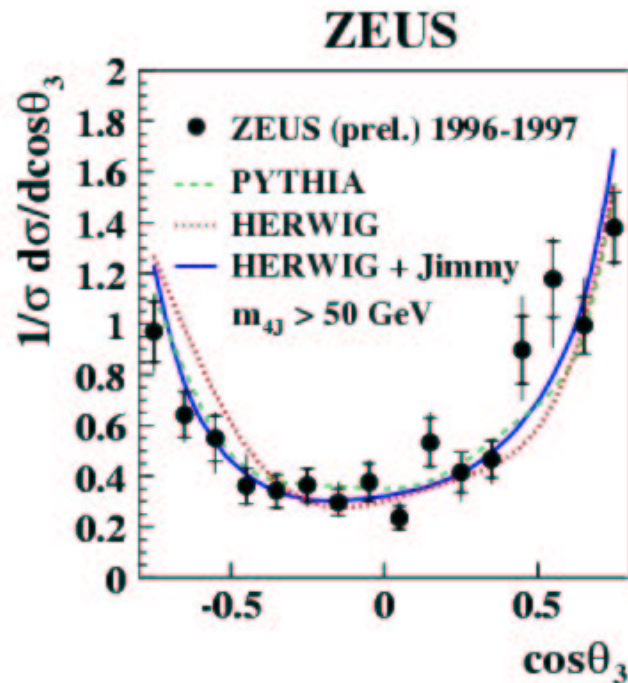


Data vs Herwig.

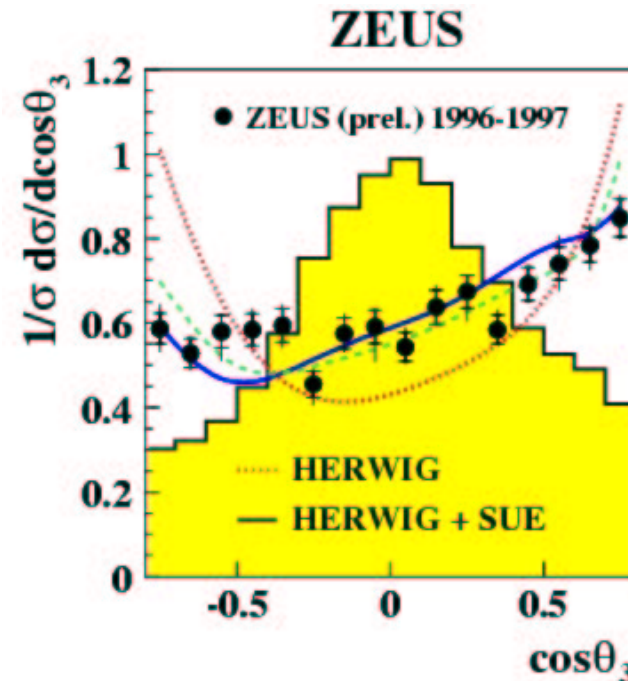
NB: HERWIG normalisation factor of 1.6x, determined by the high E_T dijet data. Parton showers do very well.

Four-jet cross sections

Photoproduction, jet transverse energy > 6 (5) GeV. No mass cut.



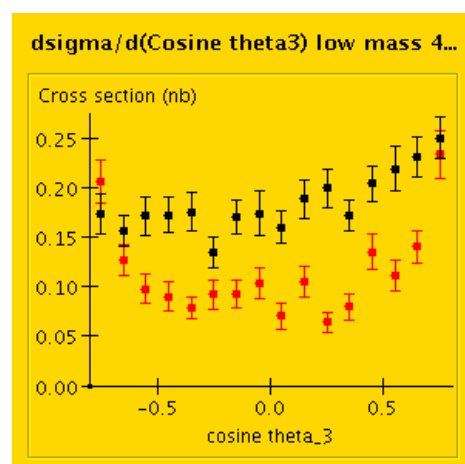
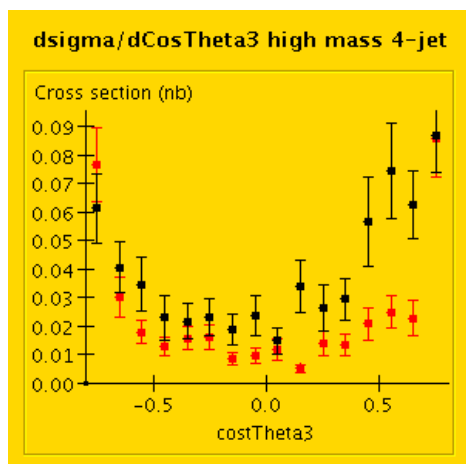
Four jet Mass > 50 GeV.
QCD (LO+PS) doing well.



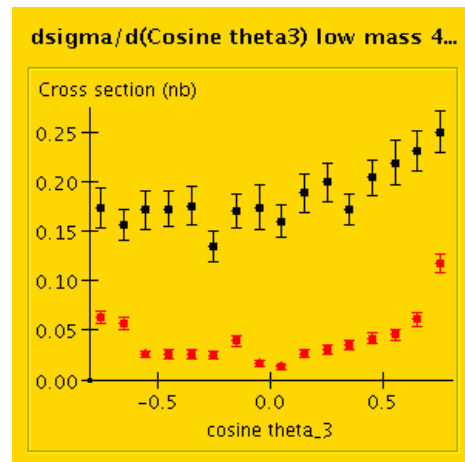
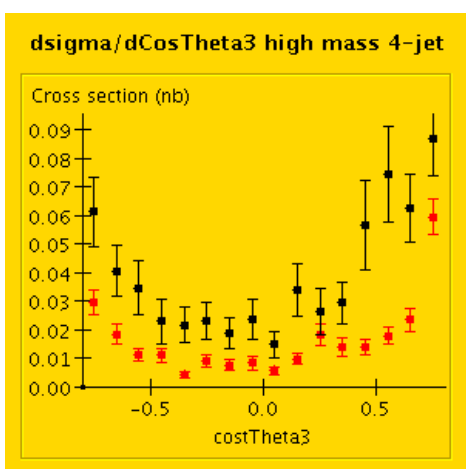
No mass cut. Need something else.
Multiparton interaction models are favoured.

Four-jet cross sections

Same data: compare absolute cross sections.



*HERWIG+JIMMY,
as tuned to Tevatron
data minimum bias
data. (I.Borozan,M.Seymour)*

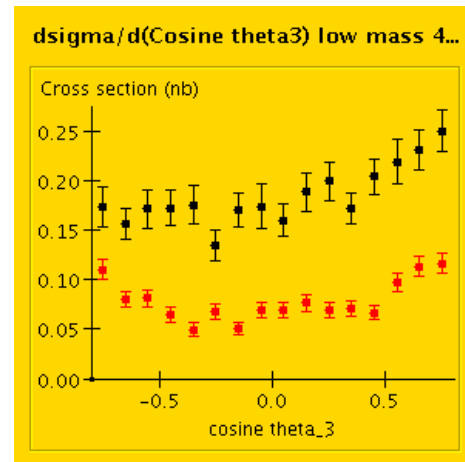
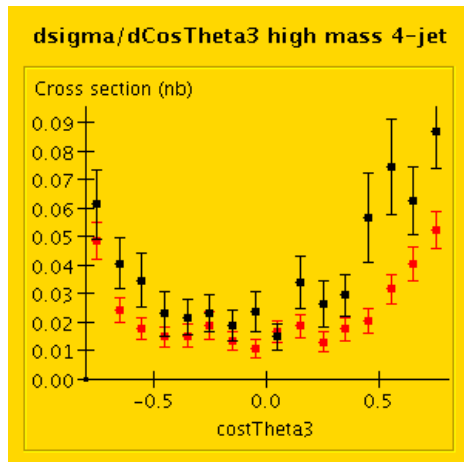


HERWIG default.

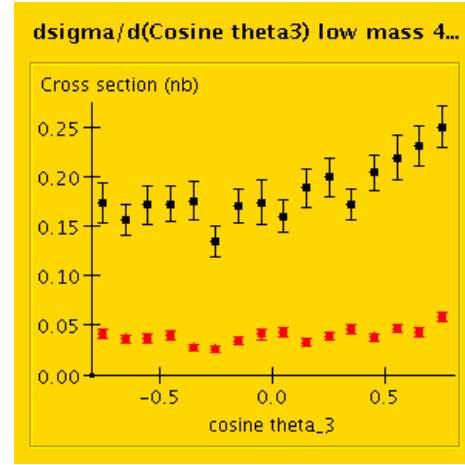
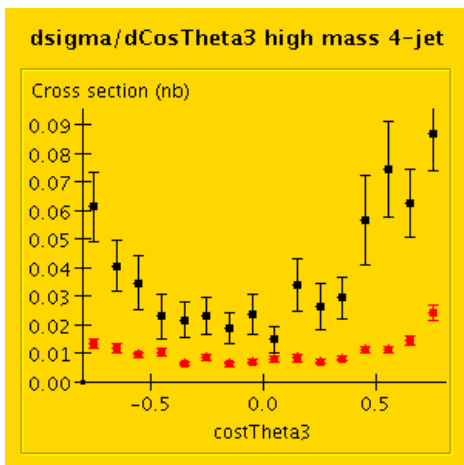
NB: Both these options give a decent fit to the high ET data.

Four-jet cross sections

Same data: compare absolute cross sections.



*PYTHIA,
as tuned to Tevatron data
minimum bias data
(R. Field; C. Buttar, A. Moraes, I. Dawson).*



PYTHIA default.

NB: Both these options give a poorer fit to the high ET data than HERWIG

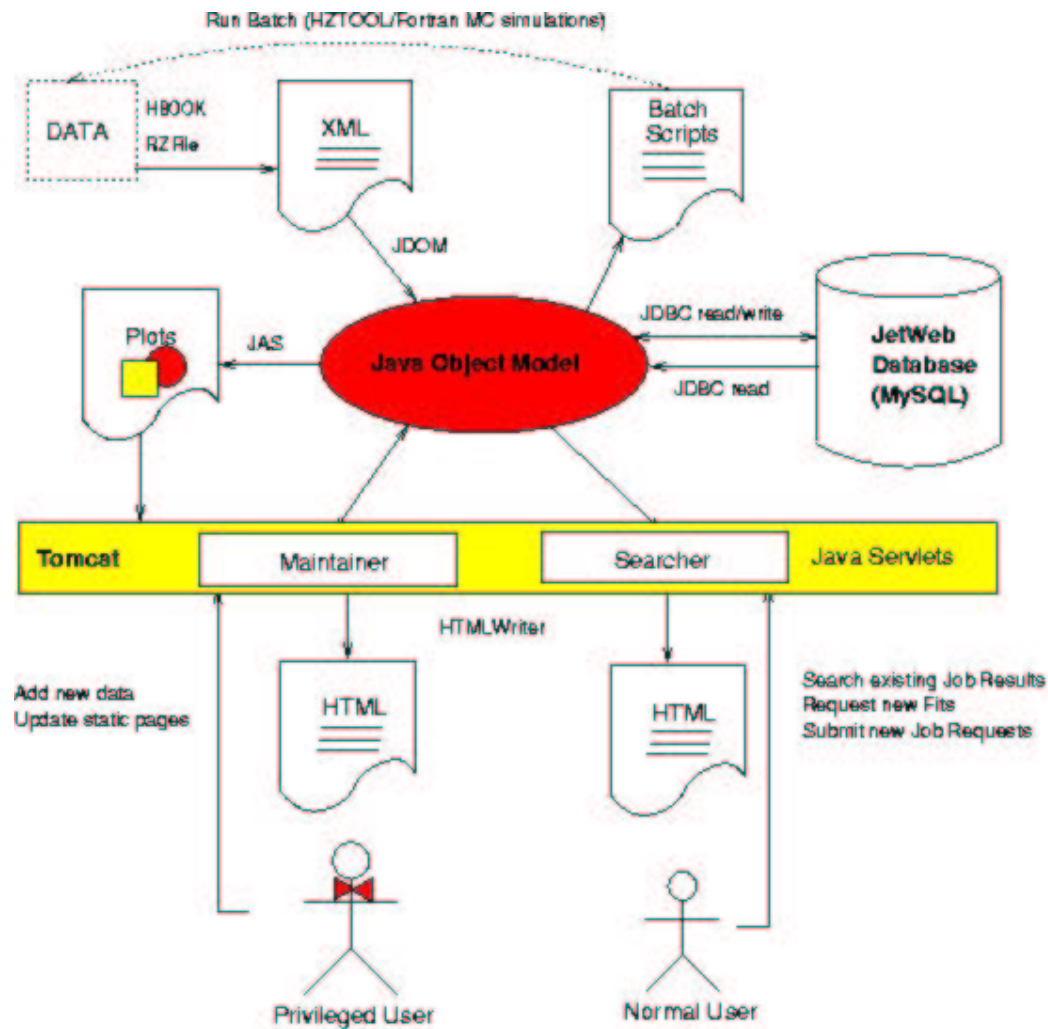
Systematic Tuning & Validation

- Many important physics effects (perturbative and otherwise) to pin down.
- Many different measurements of different processes in different kinematic regions.
- Fortunately we have general purpose MonteCarlos, and we have CPU...

Systematic Tuning & Validation

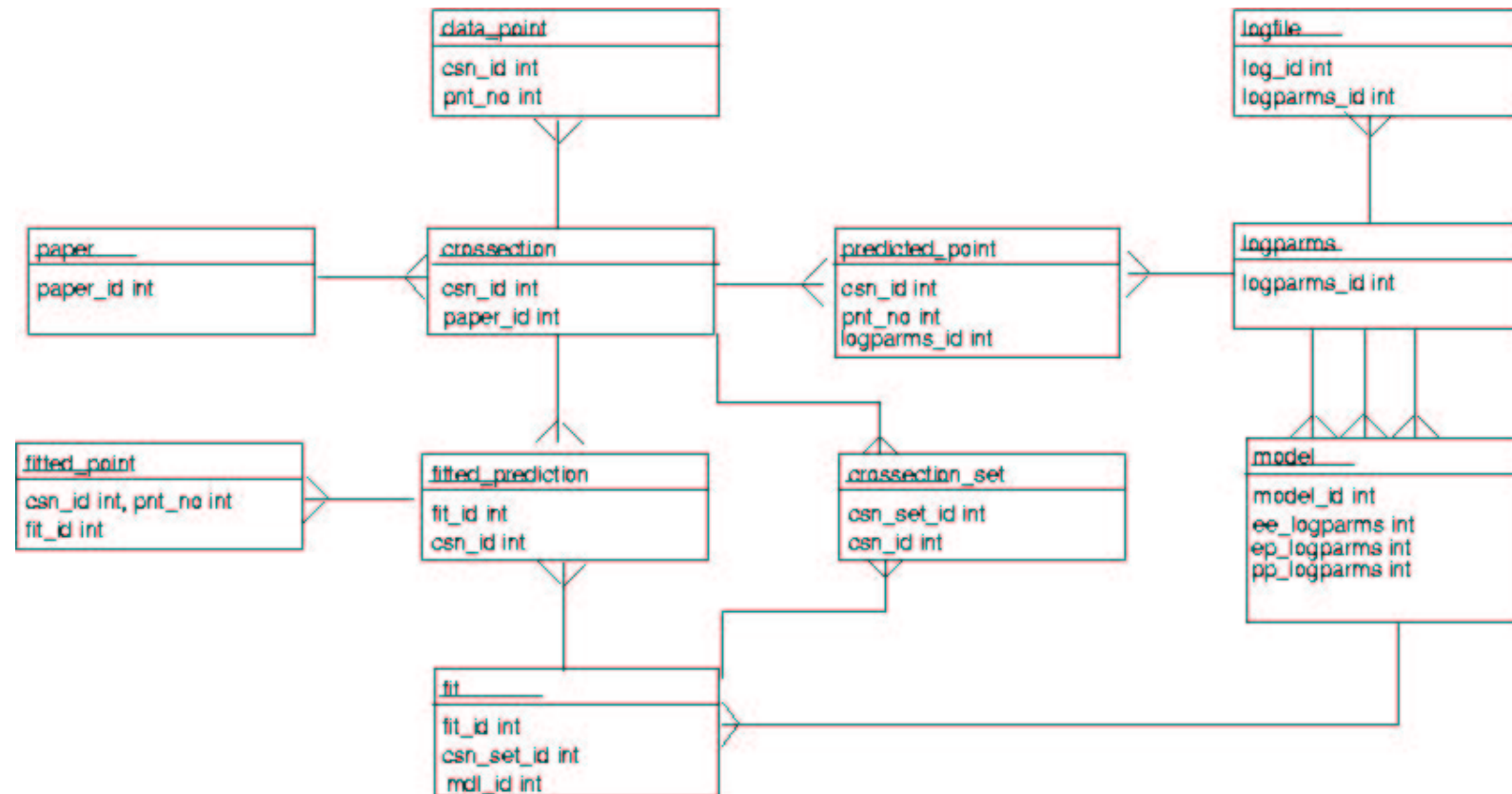
- Need facility to easily compare any new model, or tuning of model, with existing data.
- HZTOOL library provides plots to compare with data (HERA, LEP, Tevatron).
 - Fortran library, J.Bromley et al, Future Physics at HERA, vol. 1 611-612.
- Jetweb.hep.ucl.ac.uk provides easy comparison, job submission & database.
 - JMB, S.Butterworth, hep-ph/0210404.
 - HZTOOL, Herwig+Jimmy also available here via CVS

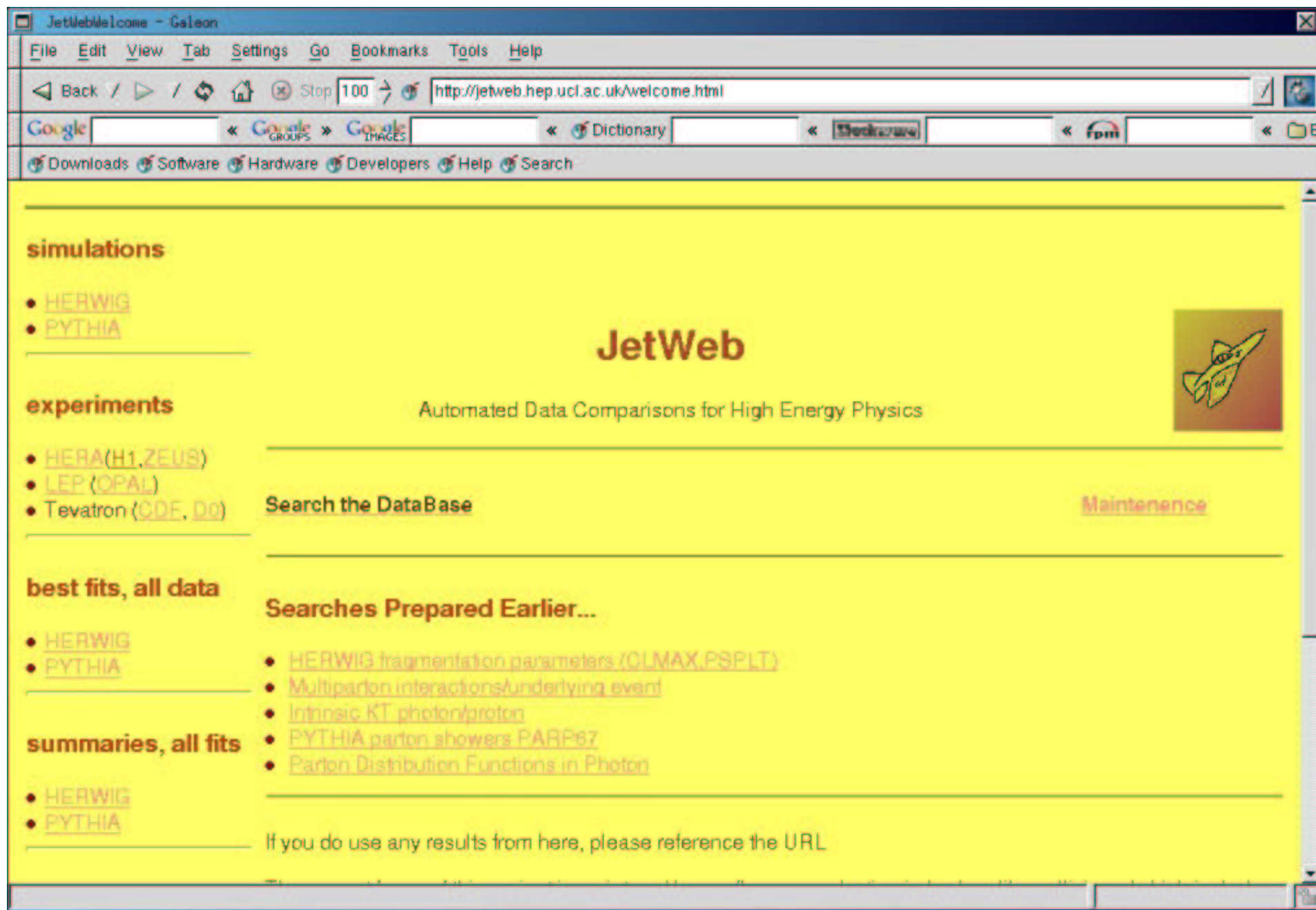
JetWeb Facility



JetWeb Database

(mySQL)





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Common parameters

Generator	Version	Minimum transverse momentum of hard scatters (GeV)	Underlying event model(Integer 0-5)	Photon PDF	Proton PDF	Intrinsic transverse momentum in photon (GeV)	Intrinsic transverse momentum in proton (GeV)
herwig <input type="checkbox"/>	v6.400 <input type="checkbox"/>		More info	GRVLO <input type="checkbox"/>	GRVLO <input type="checkbox"/>		
pythia <input type="checkbox"/>	v6.206 <input type="checkbox"/>			SaS1D <input type="checkbox"/>	CTEQ5L <input type="checkbox"/>		
	v6.100 <input type="checkbox"/>			SaS2D <input type="checkbox"/>	CTEQ4L <input type="checkbox"/>		
				WHIT2 <input type="checkbox"/>			

Change Pythia Parameters Change Herwig Parameters

Java hztool fitter, J. Butterworth, S. Butterworth

Results sorted by Fit (All ET) - Galeon

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Last updated 05-Oct-2002 at 12:24:15

HERWIG v6.100 run 30/09/2002 PDFs: Photon **GRVLO** Proton **CTEQSL** PTMIN **3.0GeV** UE **JIMMY** Photon kt:0.0 Proton kt:0.0 Scale **1.55** Model ID **97** : [Plots etc](#)

Combined: Chi2/Dof: High ET: **1.47** Low ET: **2.41** Jet Shape: **16.63** Charm: **8.13** All ET: **2.1**

HERA Lumi 6.0(+) pb⁻¹ Chi2/Dof: High ET: 1.47 Low ET: 2.12 Jet Shape: 7.9 Charm: 8.13 All ET: 1.84

LEP Lumi 400.0(+) pb⁻¹ Chi2/Dof: High ET: ? Low ET: 3.52 Jet Shape: 3.73 Charm: ? All ET: 3.52

Tevatron Lumi 0.00003(+) pb⁻¹ Chi2/Dof: High ET: ? Low ET: ? Jet Shape: 27.87 Charm: ? All ET: 2.57

HERWIG v6.100 run 30/09/2002 PDFs: Photon **WHIT2** Proton **CTEQSL** PTMIN **3.0GeV** UE **JIMMY** Photon kt:0.0 Proton kt:0.0 Scale **1.65** Model ID **241** : [Plots etc](#)

Combined: Chi2/Dof: High ET: **1.9** Low ET: **2.46** Jet Shape: **14.33** Charm: **3.05** All ET: **2.23**

HERA Lumi -0.0(+) pb⁻¹ Chi2/Dof: High ET: 1.9 Low ET: 2.22 Jet Shape: 1.15 Charm: 3.05 All ET: 2.08

LEP Lumi 300.0 pb⁻¹ Chi2/Dof: High ET: ? Low ET: 3.38 Jet Shape: 9.16 Charm: ? All ET: 3.38

Tevatron Lumi 0.00003(+) pb⁻¹ Chi2/Dof: High ET: ? Low ET: ? Jet Shape: 27.87 Charm: ? All ET: 1.97

HERWIG v6.100 run 30/09/2002 PDFs: Photon **SaS2D** Proton **CTEQSL** PTMIN **3.0GeV** UE **JIMMY** Photon kt:0.0 Proton kt:0.0 Scale **1.55** Model ID **76** : [Plots etc](#)

Combined: Chi2/Dof: High ET: **1.92** Low ET: **2.64** Jet Shape: **19.29** Charm: **13.54** All ET: **2.39**

HERA Lumi 6.0(+) pb⁻¹ Chi2/Dof: High ET: 1.92 Low ET: 2.39 Jet Shape: 12.02 Charm: 13.54 All ET: 2.19

LEP Lumi 200.0 pb⁻¹ Chi2/Dof: High ET: ? Low ET: 3.57 Jet Shape: 11.84 Charm: ? All ET: 3.57

Tevatron Lumi 0.00003(+) pb⁻¹ Chi2/Dof: High ET: ? Low ET: ? Jet Shape: 27.87 Charm: ? All ET: 2.57

Done.

JetWeb Fit No:269 - Galeon

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JetWeb Fit No:269

HERWIG v6.100 run

Date of last fit:30/09/2002

[Examine the fitted papers](#)

[HERA fit](#)


[LEP fit](#)

[Tevatron fit](#)

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Modify parameters first:



Combined this for all fitted experiments: Chi2/Dof at an overall scale factor of 1.55)

- High ET: **1.47**
- Low ET: **2.41**
- Jet Shape: **16.63**
- Charm: **8.13**
- All ET: **2.1**

Parton distribution functions: Photon **GRVLO** Proton **CTEQ5L**

PTMIN (Minimum transverse momentum for hard scatters) **3GeV**

Underlying Event Model **JIMMY**

Intrinsic KT in the photon is:0.0

Intrinsic KT in the proton is:0.0

Parton shower cutoff is:2.5

Photon radius:1.0

Proton radius:3.0

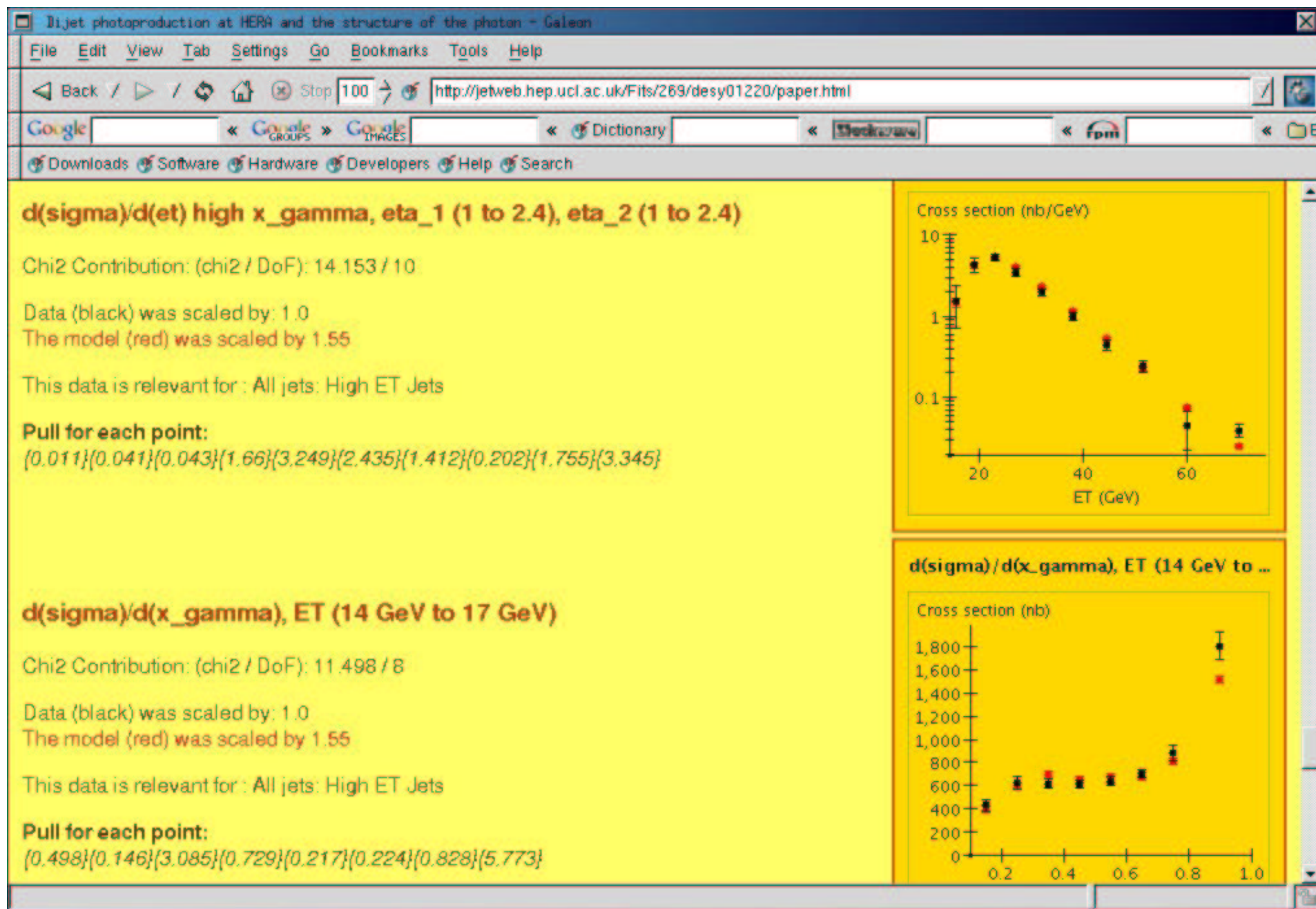
PHad:300

Fragmentation parameters CLMAX,PSPLT(1),(2):3.35,1,1

PRSOFF:0

BTCLM:1

IOPREM:1



Future

- JetWeb becomes a Grid app (job submission & database)
- Include pp & more Tevatron data
- Include more heavy flavour data
- Include LEP fits
- Extend to diffraction?
- Include other programs (NLO calculations)
- Redesign the "hztool" concept in OO ready for HERWIG++ and PYTHIA7 tuning.
- Make the best measurements we can at ATLAS.